In "The Constitution and Functions of Gases," by Severinus J. Corrigan, an attempt has been made to advance a new dynamical theory of gases, and to do away with the necessity of a continuous ether for the transmission of radiation through space.

In the ordinary kinetic theory of gases, which has been worked out so fully by Maxwell, Clausius, and others, the molecules of which the gas is composed are conceived to be in continual motion among one another, each molecule moving through a mean free path, while pressure on a surface is due to the continuous bombardment of the molecules. The theory which Mr. Corrigan advances is as strictly dynamical as the ordinarily accepted one, but is based on quite different assumptions. The molecule, instead of being in continual motion to and fro, is at rest, but is made up of a large number of atoms, which revolve in orbits, approximately circular, round the centre of the molecule with enormous velocities.

The atoms themselves are supposed to be "perfectly elastic, incompressible, spherical solids which are arranged primarily in duads or combinations of two, and the atoms of each duad combination are mutually attracted by a force in each atom, which force, like that of gravity, varies inversely as the square of the distance between the members of the duad." These two atoms are endowed with opposite polarity of some kind, probably magnetic, and are analogous to a system of binary stars of equal mass and volume, and their motion is governed by the laws of motion of celestial bodies. The molecule is supposed to be built up of an enormous number of these rapidly rotating magnetic couples with the planes of their orbits in all directions, so that the molecule is a hollow shell of gas, the surface atoms of which are in extremely rapid motion round the centre of the molecule.

The pressure of the gas is assumed to be proportional to the mass of the gas and the angular velocity or vibration frequency of the atom, while a change of pressure alters the diameter of the atomic orbit. In a very rare gas, therefore, the diameter of the atomic orbit is immensely greater than at ordinary atmospheric pressure.

Proceeding on these assumptions, the author certainly makes his theory satisfactorily account for some of the properties of gases. Great stress is laid on the theoretical deduction, from the hypothesis, of a law of radiation of identically the same form as the empirical formula of Dulong and Petit. The value of the constant is also deduced, and this is in complete agreement with the experimental value.

The ether, instead of being the continuous medium demanded by physicists, is supposed to be molecular and discontinuous—practically a gas of excessive tenuity. A large amount of space is devoted to the consideration of a mode of transmission of radiation, from molecule to molecule of the gaseous ether, with the velocity of light; but so many difficult assumptions are made in the course of it, that the explanation, though plausible, is not at all satisfactory. The impulse which the revolving atom receives from contact with a vibrating surface is supposed to be handed on from molecule to molecule with the velocity of light; but it is not clear why an atom of an adjacent molecule should always be in exactly the right position for the transmission of an impulse.

It will be of interest to mention a few of the results which the author deduces from his equations. The number of atoms in the atmospheric molecule is calculated to be about 10^{14}, and the orbital velocity of the atom of air at atmospheric pressure and temperature 500 million miles per second. The number of atoms per cubic centimetre of the gas agrees very nearly with the results deduced by Lord Kelvin and others. The density of the luminiferous ether (air = 1) is about $3 \cdot 10^{-16}$, and the diameter of a molecule of the ether ·002 inches.

As a consequence of the theory the conjugate atoms would be disrupted at an absolute temperature of 6679° Fahrenheit, and the author considers that disruptive electrical discharges, such as from an induction coil or in lightning, do break up the molecules, and it is the recombination of the dissociated atoms which causes the crash of thunder after the lightning flash.

The most unsatisfactory portion of the book is where the author endeavours to explain electrical phenomena, like atmospheric electricity, and natural disturbances, like tornadoes, by his theory of gases. A table of the dimensions and weights of the atoms of the molecules of the air and ether, which are deduced from the equations, is given; while a supplement is added to the book, deducing the same results in a different manner, and various theories are advanced in regard to the solar corona and astrophysics generally.

Though one may not agree with many of the author's assumptions, the fact remains that an interesting dynamical theory has been advanced which accounts for some phenomena not explained by any other theory; and for those who may be interested in speculations in regard to the nature and constitution of the gases and the ether, the book is well worth reading.

E. R.

IMPRESSIONS OF OUT-DOOR NATURE.

A Year in the Fields. Selections from the writings of John Burroughs. With illustrations from photographs by Clifton Johnson. Pp. ix + 220. (London: Smith, Elder, and Co., 1896.)

A-Birding on a Bronco. By Florence A. Merriam. Illustrated. Pp. x + 226. (Boston and New York: Houghton, Mifflin, and Co., 1896.)

Summer Days for Winter Evenings. By J. H. Crawford, F.L.S. Illustrations by John Williamson. Pp. ix + 274. (London: John Macqueen, 1896.)

THE highest merit in any book of natural history is that it contains new and valuable information. Such books are often, but by no means inevitably, dry. Mr. A. R. Wallace may be named as one living writer who gives us new and valuable matter in a thoroughly readable form. Without being absolutely original, a book may yet be well worth writing if it contains a good deal of useful information served up in an attractive way. Then we come to the books which are attractive but not useful, and so to the books which are neither one nor the other.

None of the books before us belong to either the

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highest or the lowest class. The naturalist may search them through without finding any passage which throws new light upon an important question. Perhaps we may, rather doubtfully, put "A Year in the Fields" among the books that both amuse and instruct. Mr. Burroughs is most agreeable to read, and now and then he tells us something that we are glad to know. But he sacrifices a little too much to the necessity of pleasing, and his books are impressions rather than studies. Miss Merriam and Mr. Crawford definitely belong to the class which amuses and does not instruct.

Mr. Burroughs has now found his public, and needs no lengthy notice at our hands. He writes as one who lives in daily contact with nature, occupying himself with her superficial aspects rather than with her problems. The reader of his books finds many pleasant pages, like the best descriptive passages of good novels, and occasionally a hint of some curious knowledge or reflection. Such a book as that before us (which, it is necessary to note, contains no new essays) is welcome to the naturalist in his less serious moods; it is genuine literature with a strong flavour of the woods and fields. The volume is illustrated by twenty photographs, of which all but one contain the author's figure in some favourite haunt. It is cheerful to think that he has now escaped from the public office, and is entering old age as a fruit-farmer on the Hudson.

Miss Merriam tells in a sprightly way her observations upon live birds in California. The Bronco is an old horse, from whose back she studied the birds with an opera-glass. The book is crowded with details, but they are hardly ever worth remembering; it relies upon its literary qualities, which are good, but not excellent. There are many illustrations, chiefly of nests or birds' heads.

Mr. Crawford's book is even thinner in substance than Miss Merriam's. A facile writer could come home after sitting for an hour in a garden-chair, or sauntering along a lane, and write such sketches as these almost without effort. They incline to the sermon in some places, to the novel in others. The very best remark in the book, from the naturalist's point of view, is this (p. 100): "The feet [of the lark] are adapted for running. They cover so many of the grass stems at once, that not only does the bird get along very much as one does on snow-shoes, but the elasticity of the pressed-down herbage aids in the spring." The illustrations have no natural history value.

L. C. M.

OUR BOOK SHELF.

Guide pour le Soufflage du Verre. By Prof. H. Ebert. Translated from the second German edition, with notes by Prof. P. Lugol. Pp. 191. (Paris: Gauthier-Villars et Fils, 1897.)

THE utility and importance of even a small amount of knowledge in the art of blowing glass is perhaps best known to those who work in chemical, physical, and astrophysical laboratories. Tubes will crack, pumps will get broken, and many other similar mishaps will occur in the ordinary course of laboratory work. In such cases two remedies are available: either new apparatus must be bought, or it must be made. The former is doubtless the easiest, but the most expensive; while the latter is, in many cases, a saving of both time and money.

In England, Mr. Shenstone's little book on the methods of glass-blowing is the one which is most generally used. Prof. Ebert practically based his first edition on this admirable little treatise, embodying in it both his own observations and methods and those of others. The second edition, however, was considerably altered; in fact the book was practically reconstructed, as it was his intention to insert results of more recent experience, and give a strictly systematic course on glass-blowing.

The book before us is a French translation of this second edition, and it will be found to give full details to its readers how to make all the more common glass apparatus in use in laboratories, and how to mend those when broken. Prof. Ebert has adopted a logical sequence of the chapters, leading the glass-blower gradually by easy stages to the more difficult operations. The reader is first made to understand the mysteries of the blow-pipe itself. He is next given exercises which involve the training of the hands, first singly and then together. More difficult exercises are then put before him, from the construction of a trap to some complicated forms of vacuum tubes. In each lesson the necessary steps are clearly described, and in many cases illustrations are given showing the appearance of the apparatus at its several stages. This is an important point, for the great difficulty that a beginner meets with at first is not so much the actual making of the apparatus (which is acquired after a little practice), but a lack of knowledge of the various steps that have to be accomplished before the final stage is reached. For example, to make a large bulb in the middle of a tube, the beginner generally tries to blow the bulb directly without adopting the more easy stages of blowing three small bulbs close together, and amalgamating them into one large one.

The appendix contains some additional information which will be found useful to those working with glass, such as engraving on glass, the graduation of tubes, &c. Some further notes have also been added by the translator.

As a treatise on glass-blowing, Prof. Ebert's book can be thoroughly recommended, and those who are unable to master the German edition will find Prof. Lugol's translation an admirable substitute.

W. J. S. L.

Projectiles de Campagne de Siège et de Place: Fusées. By E. Vallier. Pp. 178. (Paris: Gauthier-Villars.)

L'Éclairage. Éclairage aux gaz, aux huiles, aux acides, gras, &c. By Prof. Julien Lefèvre. Pp. 180. (Same publishers.)

Les Succédanés du Chiffon en Papeterie. By V. Urbain. Pp. 179. (Same publishers.)

THESE three volumes belong to the very practical series published under the editorship of M. Léauté, as the Encyclopédie scientifique des Aide-Mémoire.

M. Vallier confines himself to dealing with the projectiles from large guns. The first part of the book is concerned with field artillery (*projectiles de campagne*); the second with ordinary cast shells, shrapnels, and explosive shells (*projectiles de siège et de place*), and the third with fuses arranged to explode when the projectile collides, or at a given point of the trajectory. The volume is full of instructive information on the manufacture, properties, and mode of employment of different types of projectiles used in ordnance pieces.

In "L'Eclairage," Prof. Lefèvre first describes the principles of various systems of illumination, excluding electric lighting. He deals with the many processes involved in the production of gas from coal, and shows how gas is distributed. The many methods employed to burn gas most effectively are also described. Lighting by special gases, and by acetylene, form the subject of two other chapters. In a similar way lighting with candles,

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